The Effect of Olive –Seed Oil Fuel on Diesel Engine

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Abstract

Air pollution is a major problem that it cannot be ignored in nowadays, as it affects the human health and mainly the body's respiratory system, the cardiovascular system, plants and property. Some important pollutants that take part in causing the air pollution are carbon monoxide, nitrogen oxide and many other compounds that contain the carbon in large amounts such as organic compounds. These toxic components mixed with air of the environment and make the air polluted. Fuel quality has very strongly influences in diesel engine emissions like HC, CO, NOx and particulate emissions. This is due to the fact that fuel emissions depend on the formation and the combustion of the mixture. At the present paper will be examined the behavior of gas emissions in a four stroke engine when changes the temperature of fuel. The temperatures of fuel that has been used for the experiment were 10^oC, 20^oC, 30^oC, 40^oC, 50^oC and 60^oC. In addition, it has been used the following mixtures of fuels: diesel-5% olive seed oil, diesel-10% olive seed oil, diesel-20% olive seed oil, diesel-30% olive seed oil, diesel-40% olive seed oil, diesel-50% olive seed oil. For the above temperatures, it has been measured the gas emissions of carbon monoxide (CO), hydrocarbons (HC), nitrogen monoxide (NO) and smoke. Also it has been measured the gas emissions temperatures and the fuel consumption is examined too.

Keywords

Gas Emissions; Olive Seed Oil; Biofuels; Fuel Temperature

Introduction

Air pollution is called the addition of harmful substances to the atmosphere resulting in damage to the environment, human health, and quality of life. Air pollution originates from both natural and anthropogenic sources. Many of our daily activities release chemicals and particles into the air we breath. For example, motor vehicles release chemicals from their exhausts, particles and other chemicals are released out of the chimney when we use fires and log burners to heat our homes. The amount of air pollution in the air depends on the amount of pollution produced and the rate at which the pollutants disperse[1,2,3,4]. Moreover, in areas where the wind is very strong, pollution is dispersed and blown away. In areas where there is little or no wind air pollution accumulates and concentrations can be high. However, local factors such as topography (hills and mountains), proximity to the coast, building height and time of the year all affect local wind conditions and can play a role in increasing air pollution levels[5,6,7,8]. Vehicle exhaust emissions are a major source of air pollution, as vehicles emit a series of air pollutants, including carbon monoxide, sulfur oxides and nitrogen oxides, through the tailpipe gases due to internal combustion of various fuels. A recent study estimated that 399 people will die prematurely each year because of vehicle air pollution. Biofuels are the best way of reducing vehicle emissions. Furthermore, biofuel in it's most natural form can be used in many different things including cars, trucks, tractors and just about anything that has a combustible engine. It's most commonly used as an additive in the production of diesel fuel. When it is used as an additive, it helps to eliminate a percentage of the harmful products of burning diesel such as carbon monoxide and hydrocarbons. There are many types of biofuels, including vegetable oils, biodiesel, bioalcohols, ethanol and biogas[9,10,11].

Biodiesel is a common biofuel that is used throughout the world. It is made through a process, in which it breaks down the different types of oils and fats. Bioalcohol is very common biofuel too. It is produced

during the natural fermentation process that takes place when sugar and microorganisms are mixed together. Ethanol is produced from agricultural crops or from recycled wastes and residues. It can be put to use petrol engines as a substitute for gasoline or it can be mixed with gasoline in any ratio. The quality of fuel affects diesel engine emissions (HC, CO, NOx and particulate emissions) very strongly. The fuel that is used in diesel engines is a mixture of hydrocarbons and its boiling temperature is approximately 170oC to 360oC [12,13,14,15]. Diesel fuel emissions composition and characteristics depend on mixture formation and combustion. In order to compare the quality of fuels the following criteria are tested: ketene rating, density, viscosity, boiling characteristics, aromatics content and sylph content. For environmental compatibility, the fuel must have low density, low content of aromatic compounds, low sylph content and high ketene rating [16,17]. The question that arises is how a four-stroke diesel engine behaves on the side of pollutants and operation, when it uses diesel –olive seed oil mixtures as fuel in different fuel temperatures[18].

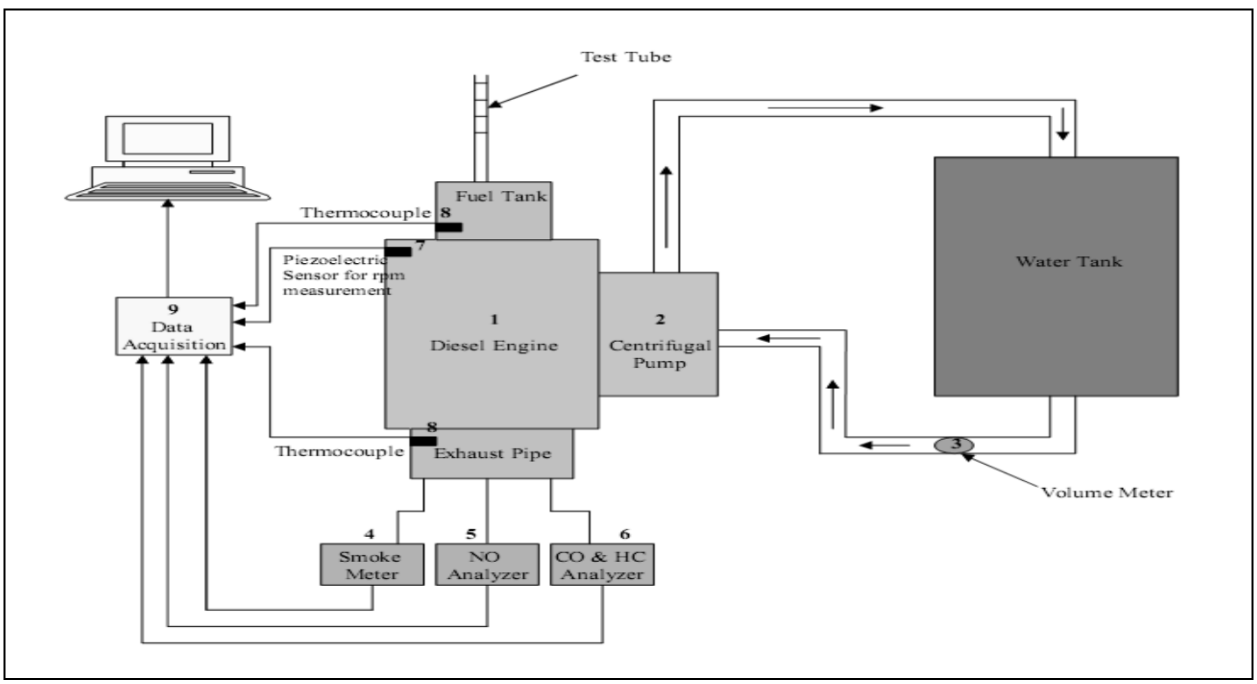
Intrumentation and experimental results

Specifically it has been used the following fuel mixtures: diesel-5% olive seed oil (Pyrin5%), diesel-10% olive seed oil (Pyrin10%), diesel-20% olive seed oil (Pyrin20%), diesel-30% olive seed oil (Pyrin30%), diesel-40% olive seed oil (Pyrin40%), diesel-50% olive seed oil (Pyrin50%), at different temperatures: 10°C, 20°C, 30°C, 40°C, 50°C and 60°C in a four-stroke diesel engine with volume 377cc, maximum power 8.2hp/3000rpm, who was connected with a pump of water centrifugal. Measurements were made when the engine was functioned on 1000, 1500, and 2000rpm.

During the experiments, it has been measured:

- The percent (%) of CO
- The ppm (parts per million) of HC
- The ppm (parts per million) of NO
- The percent of smoke
- Fuel consumption
- Gas emissions temperature

The measurement of rounds/min of the engine was made by a portable tachometer (Digital photo/contact tachometer) named LTLutron DT-2236. Smoke was measured by a specifically measurement device named SMOKE MODULE EXHAUST GAS ANALYSER MOD 9010/M, which has been connected to a PC unit. The CO and HC emissions have been measured by HORIBA Analyzer MEXA-324 GE. The NO emissions were measured by a Single GAS Analyser SGA92-NO.



PICTURE1. EXPERIMENTAL LAYOUT

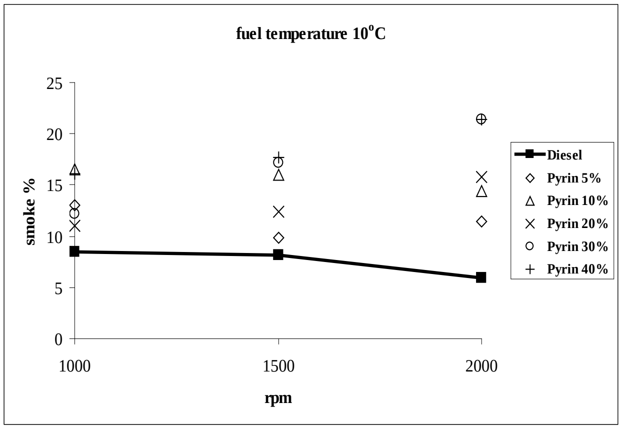


FIGURE 1 THE % OF SMOKE AVERAGE VALUE VARIATION ON DIFFERENT RPM REGARDING TO THE DIESEL-SEED OIL MIXTURES AT 10^{O}C FUEL TEMPERATURE

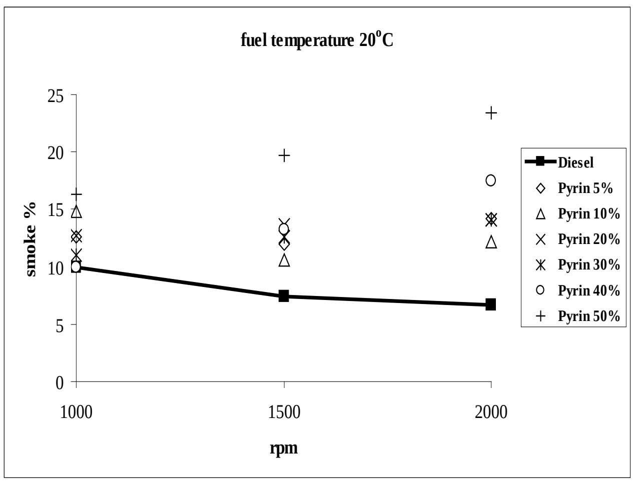


FIGURE 2 THE SMOKE AVERAGE VALUE VARIATION ON DIFFERENT RPM REGARDING TO THE DIESEL-SEED OIL MIXTURES AT 20^{O}C FUEL TEMPERATURE

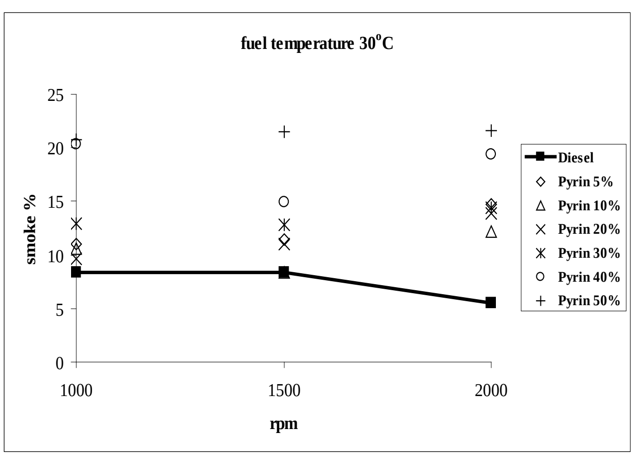


FIGURE 3 THE SMOKE AVERAGE VALUE VARIATION ON DIFFERENT RPM REGARDING TO THE DIESEL-SEED OIL MIXTURES AT 30^{O}C FUEL TEMPERATURE

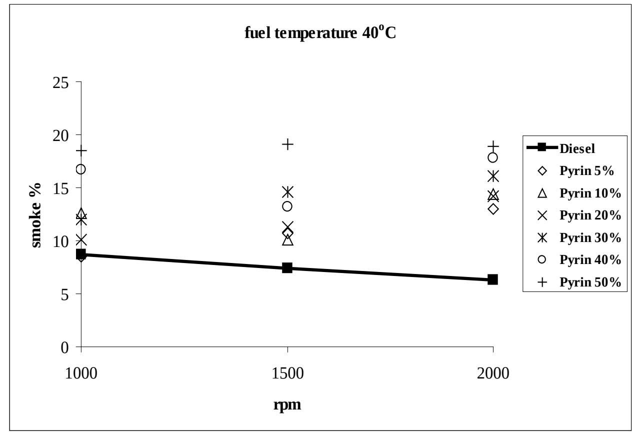


FIGURE 4 THE SMOKE AVERAGE VALUE VARIATION ON DIFFERENT RPM REGARDING TO THE DIESEL-SEED OIL MIXTURES AT 40^{O}C FUEL TEMPERATURE

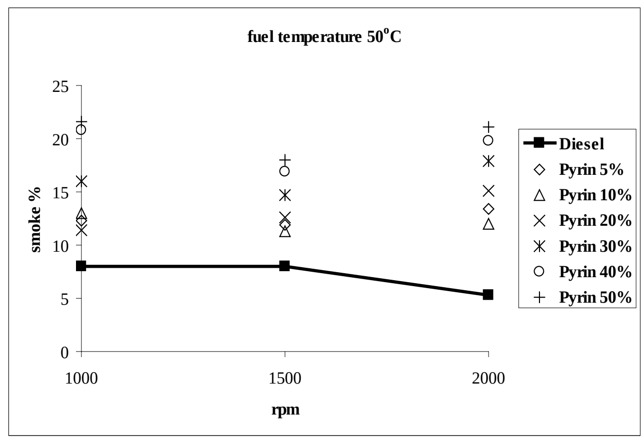


FIGURE 5 THE % OF SMOKE AVERAGE VALUE VARIATION ON DIFFERENT RPM REGARDING TO THE DIESEL-SEED OIL MIXTURES AT 50^{O}C FUEL TEMPERATURE

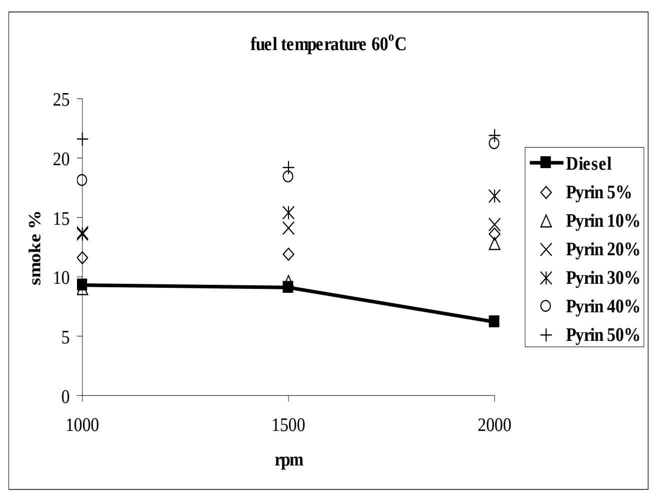


FIGURE 6. THE SMOKE AVERAGE VALUE VARIATION ON DIFFERENT RPM REGARDING TO THE DIESEL-SEED OIL MIXTURES AT 60^{O}C FUEL TEMPERATURE

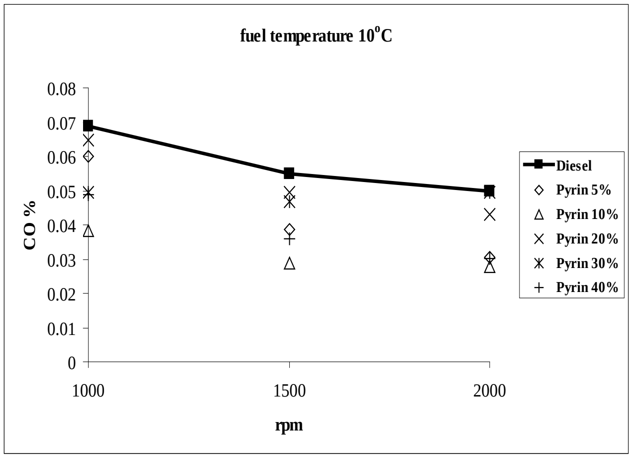


FIGURE 7 THE CO AVERAGE VALUE VARIATION ON DIFFERENT RPM REGARDING TO THE DIESEL-SEED OIL MIXTURES AT 10^{O}C FUEL TEMPERATURE

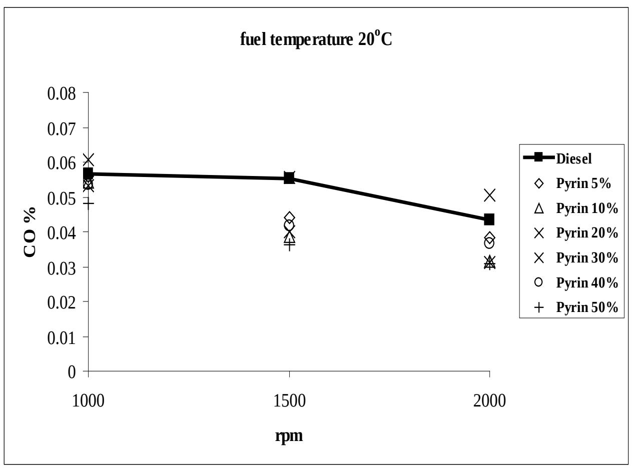


FIGURE 8 THE CO AVERAGE VALUE VARIATION ON DIFFERENT RPM REGARDING TO THE DIESEL-SEED OIL MIXTURES AT 20OC FUEL TEMPERATURE

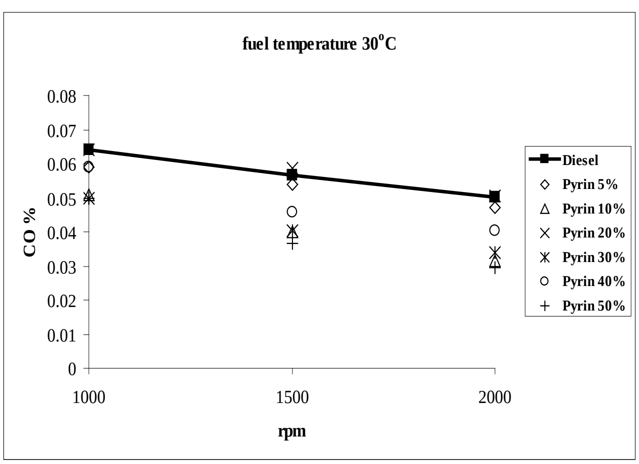


FIGURE 9 THE CO AVERAGE VALUE VARIATION ON DIFFERENT RPM REGARDING TO THE DIESEL-SEED OIL MIXTURES AT 30OC FUEL TEMPERATURE

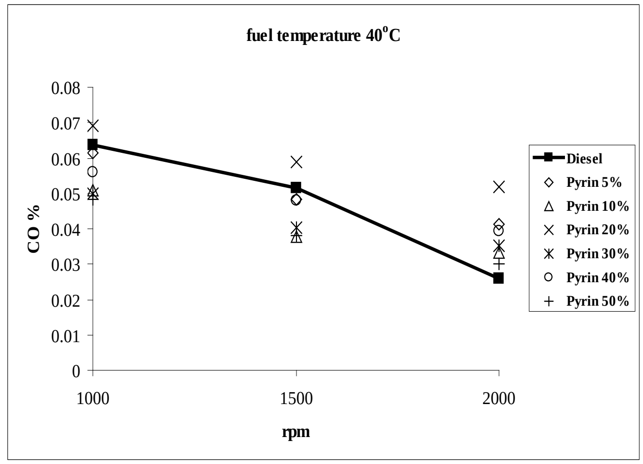


FIGURE 10 THE CO AVERAGE VALUE VARIATION ON DIFFERENT RPM REGARDING TO THE DIESEL-SEED OIL MIXTURES AT 40OC FUEL TEMPERATURE

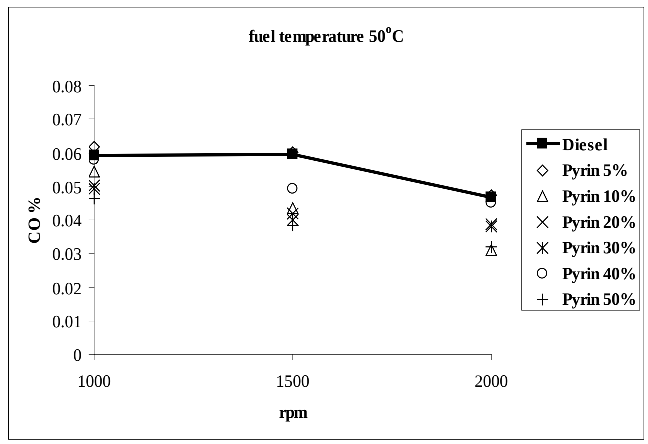


FIGURE 11 THE CO AVERAGE VALUE VARIATION ON DIFFERENT RPM REGARDING TO THE DIESEL-SEED OIL MIXTURES AT 50OC FUEL TEMPERATURE

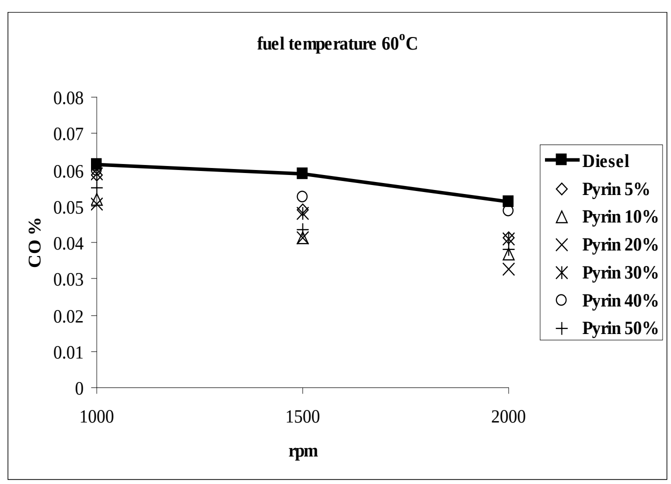


FIGURE 12 THE CO AVERAGE VALUE VARIATION ON DIFFERENT RPM REGARDING TO THE DIESEL-SEED OIL MIXTURES AT 60OC FUEL TEMPERATURE

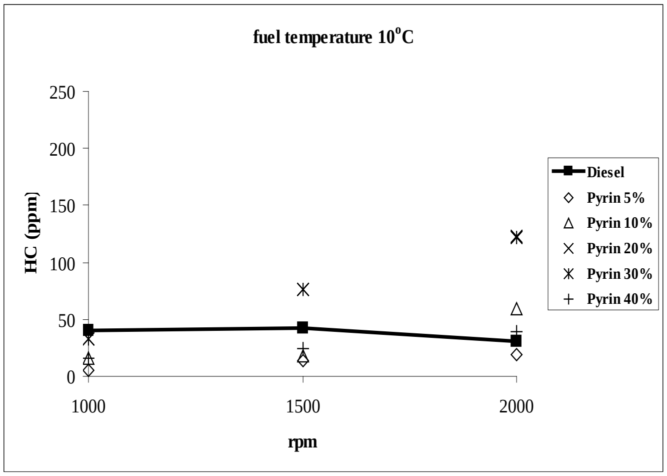


FIGURE 13 THE HC AVERAGE VALUE VARIATION ON DIFFERENT RPM REGARDING TO THE DIESEL-SEED OIL MIXTURES AT 10OC FUEL TEMPERATURE

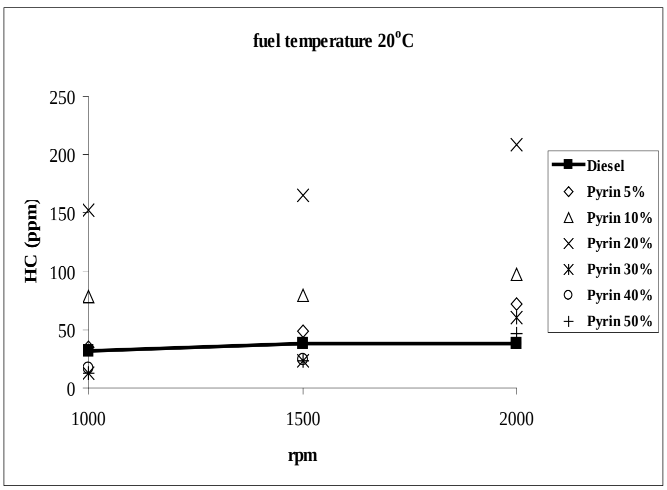


FIGURE 14 THE HC AVERAGE VALUE VARIATION ON DIFFERENT RPM REGARDING TO THE DIESEL-SEED OIL MIXTURES AT 20OC FUEL TEMPERATURE

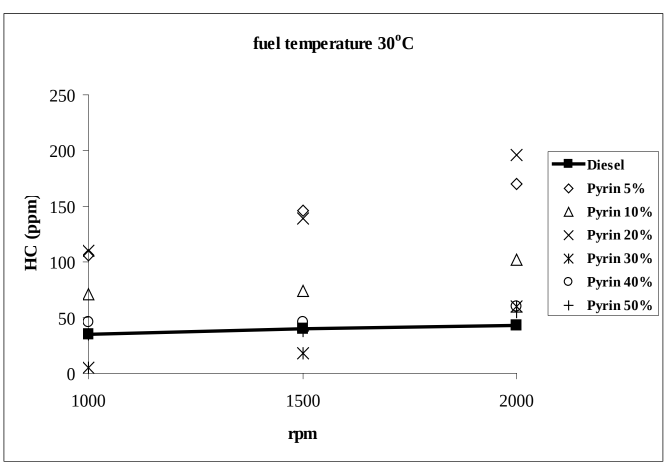


FIGURE 15 THE HC AVERAGE VALUE VARIATION ON DIFFERENT RPM REGARDING TO THE DIESEL-SEED OIL MIXTURES AT 30OC FUEL TEMPERATURE

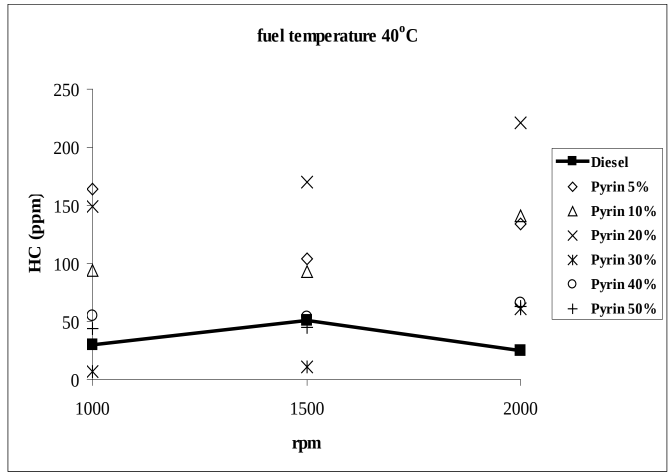


FIGURE 16 THE HC AVERAGE VALUE VARIATION ON DIFFERENT RPM REGARDING TO THE DIESEL-SEED OIL MIXTURES AT 40OC FUEL TEMPERATURE

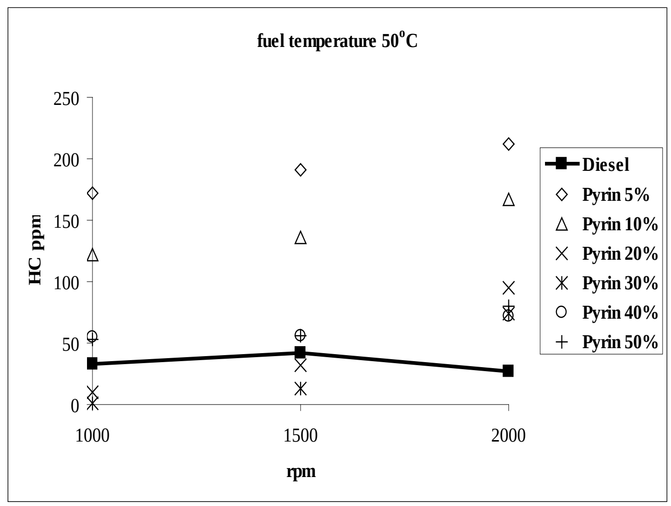


FIGURE 17 THE HC AVERAGE VALUE VARIATION ON DIFFERENT RPM REGARDING TO THE DIESEL-SEED OIL MIXTURES AT 50OC FUEL TEMPERATURE

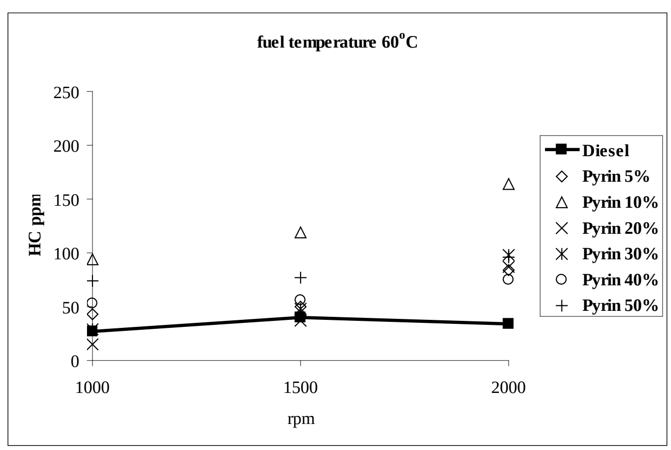


FIGURE 18 THE HC AVERAGE VALUE VARIATION ON DIFFERENT RPM REGARDING TO THE DIESEL-SEED OIL MIXTURES AT 60OC FUEL TEMPERATURE

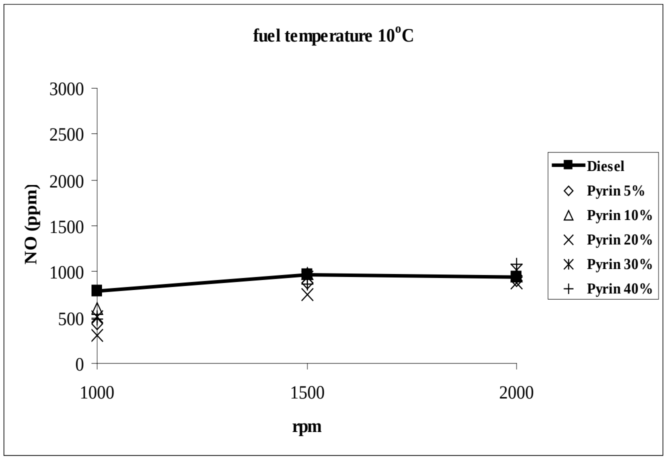


FIGURE 19 THE NO AVERAGE VALUE VARIATION ON DIFFERENT RPM REGARDING TO THE DIESEL-SEED OIL MIXTURES AT 10OC FUEL TEMPERATURE

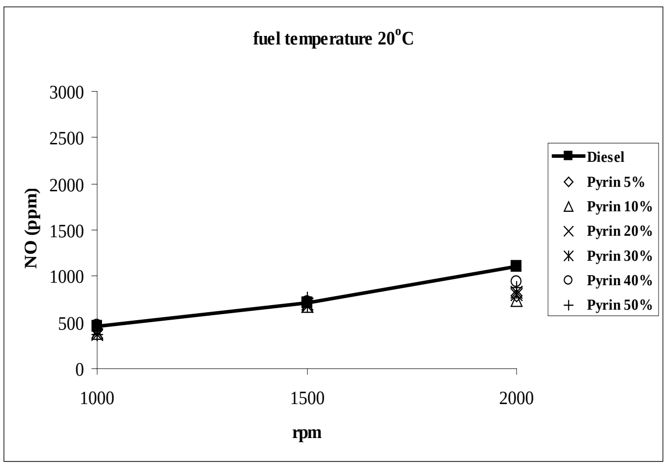


FIGURE 20 THE NO AVERAGE VALUE VARIATION ON DIFFERENT RPM REGARDING TO THE DIESEL-SEED OIL MIXTURES AT 20OC FUEL TEMPERATURE

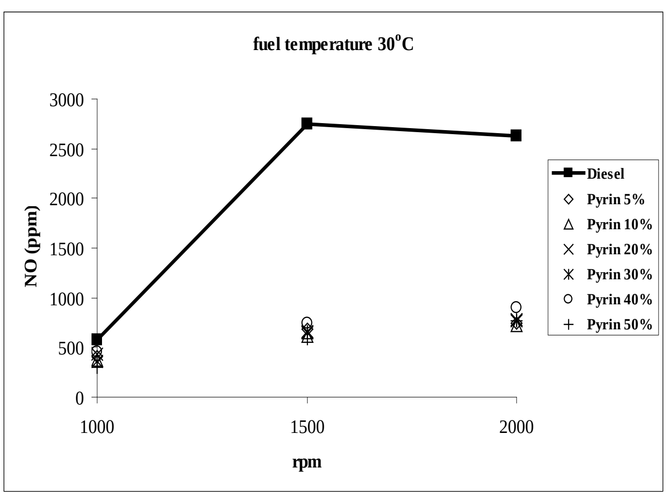


FIGURE 21 THE NO AVERAGE VALUE VARIATION ON DIFFERENT RPM REGARDING TO THE DIESEL-SEED OIL MIXTURES AT 30OC FUEL TEMPERATURE

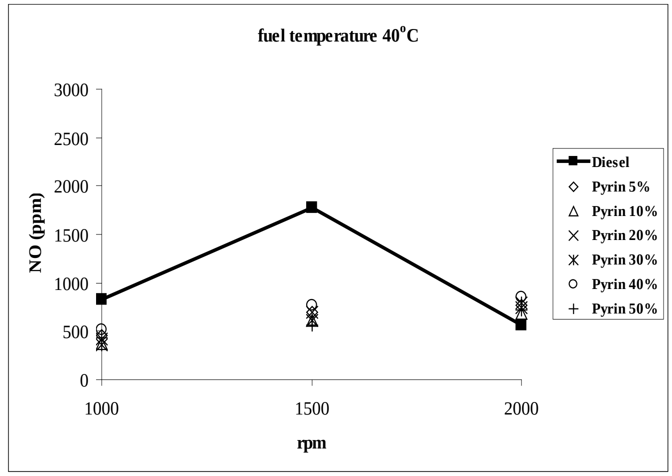


FIGURE 22 THE NO AVERAGE VALUE VARIATION ON DIFFERENT RPM REGARDING TO THE DIESEL-SEED OIL MIXTURES AT 40OC FUEL TEMPERATURE

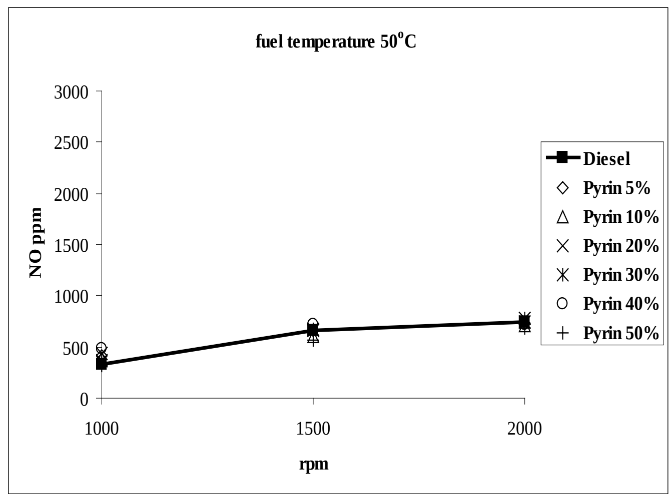


FIGURE 23 THE HC AVERAGE VALUE VARIATION ON DIFFERENT RPM REGARDING TO THE DIESEL-SEED OIL MIXTURES AT 50OC FUEL TEMPERATURE

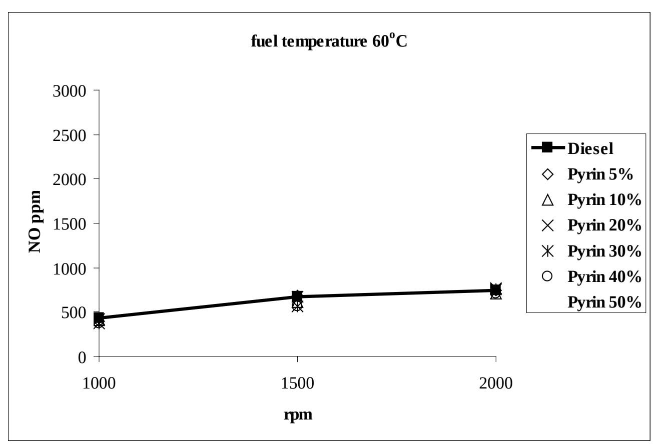


FIGURE 24 THE NO AVERAGE VALUE VARIATION ON DIFFERENT RPM REGARDING TO THE DIESEL-SEED OIL MIXTURES AT 60OC FUEL TEMPERATURE

The diesel-seed oil mixture has different viscosity due to different content of seed oil. If ''η'' stands for viscosity, then it is [9]:

ηpyrin5%< ηpyrin10%< ….< ηpyrin40%< ηpyrin50%

Also, the viscosity varies with the temperature, so it is [9]:

ηpyrin5%(10^{o}C) > ηpyrin5%(20^{o}C) > . > ηpyrin5%(60^{o}C)

ηpyrin50%(10^{o}C) > ηpyrin50%(20^{o}C)>. > pyrin50%(60^{o}C)

As far as the consumption is concerned, it has been observed small changes with the change of temperature, but because the difference is minor there is no need to mention it.

The change in the fuel temperature in the various mixtures, has the following results:

Smoke:

- In terms of smoke emissions, diesel presented the best behavior than mixtures of diesel-olive seed oil.
- CO:
- Pyrin 10%: The best behavior is observed in the case of 10oC fuel temperature.
- Pyrin 50%: The best behavior is observed in the case of 20^{o}C, 30^{o}C, 40^{o}C, 50^{o}C, 60^{o}C fuel temperature.
- HC:
- Pyrin 5%: The best behaviour is observed in the case of 10oC fuel temperature.
- Pyrin 30%: It has been observed better behavior in the cases of 20^{o}C, 30^{o}C, 40^{o}C, 50^{o}C fuel temperatures. However, when the fuel temperature is 60oC diesel presented the best behavior.
- NO:
- Pyrin 10%: The best behaviour appeared when the fuel temperature was 20^{o}C, 30^{o}C, 40^{o}C, 50^{o}C and 60^{o}C in all rpm.
- Pyrin 20%: The best behaviour appeared when the fuel temperature was 10^{o}C in all rpm.

Conclutions

Moreover, air pollution is made up of many kinds of gases, droplets and particles that reduce the quality of the air. During the past hundred years and especially with increasing urbanization and industrialization, humans started to release more wastes into the atmosphere than nature could cope with. As a result, air pollution is created and has become a major persistent problem too. Two of the main human-made sources of air pollution in urban areas are transportation and fuel combustion in stationary sources, including residential, commercial and industrial heating and cooling. Summarizing all the above, it can be said that the fuel temperature influences the viscosity of the fuel and gas emissions too. Each one is influenced in a different way, and no one can determine that in a specific temperature will be observed variations in all gas emissions (smoke, CO, HC, NO). Also it should be taken into consideration that the fuels that have been used were diesel-seed oil mixtures with different contents and viscosity in the same temperature. In any case, it is important to mention that the fuel temperature influences the concentration of gas emissions. The temperature of gas emissions has not been influenced either from the fuel temperature, or from the use of different mixtures of diesel-olive seed oil too. Finally, it is important to mention that during the use of mixtures of diesel-olive seed oil, it has not been presented malfunction in the engine or increase of fuel consumption. Renewable fuels, will replace petroleum-based fuels in the near future because petroleum reserves are not sufficient enough to last many years. Also, the severe environmental problems around the world will eventually lead to the use of more environmentally friendly technologies.

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